Food consumption and male and female physical stature in the Netherlands during the 19th century

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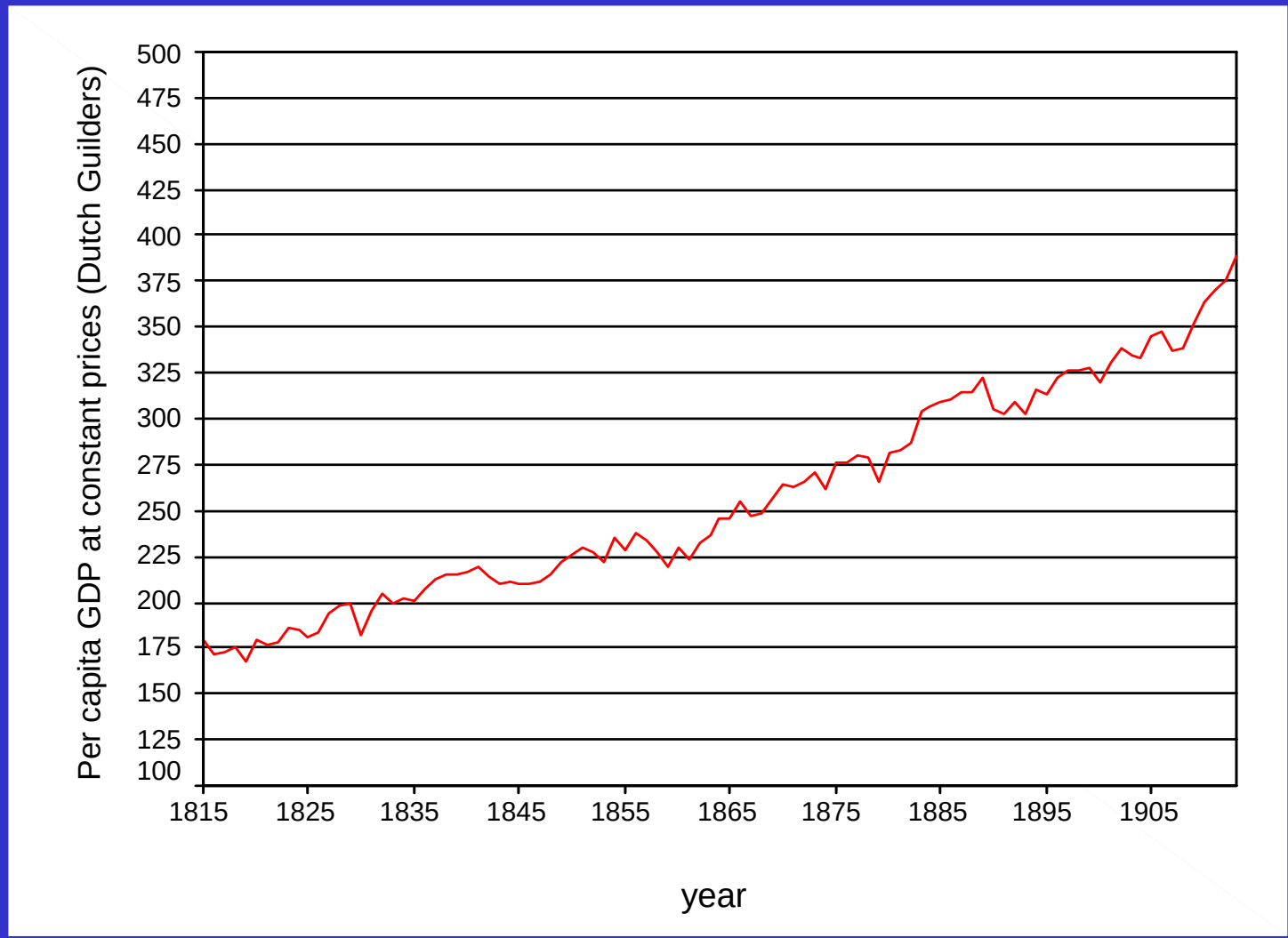
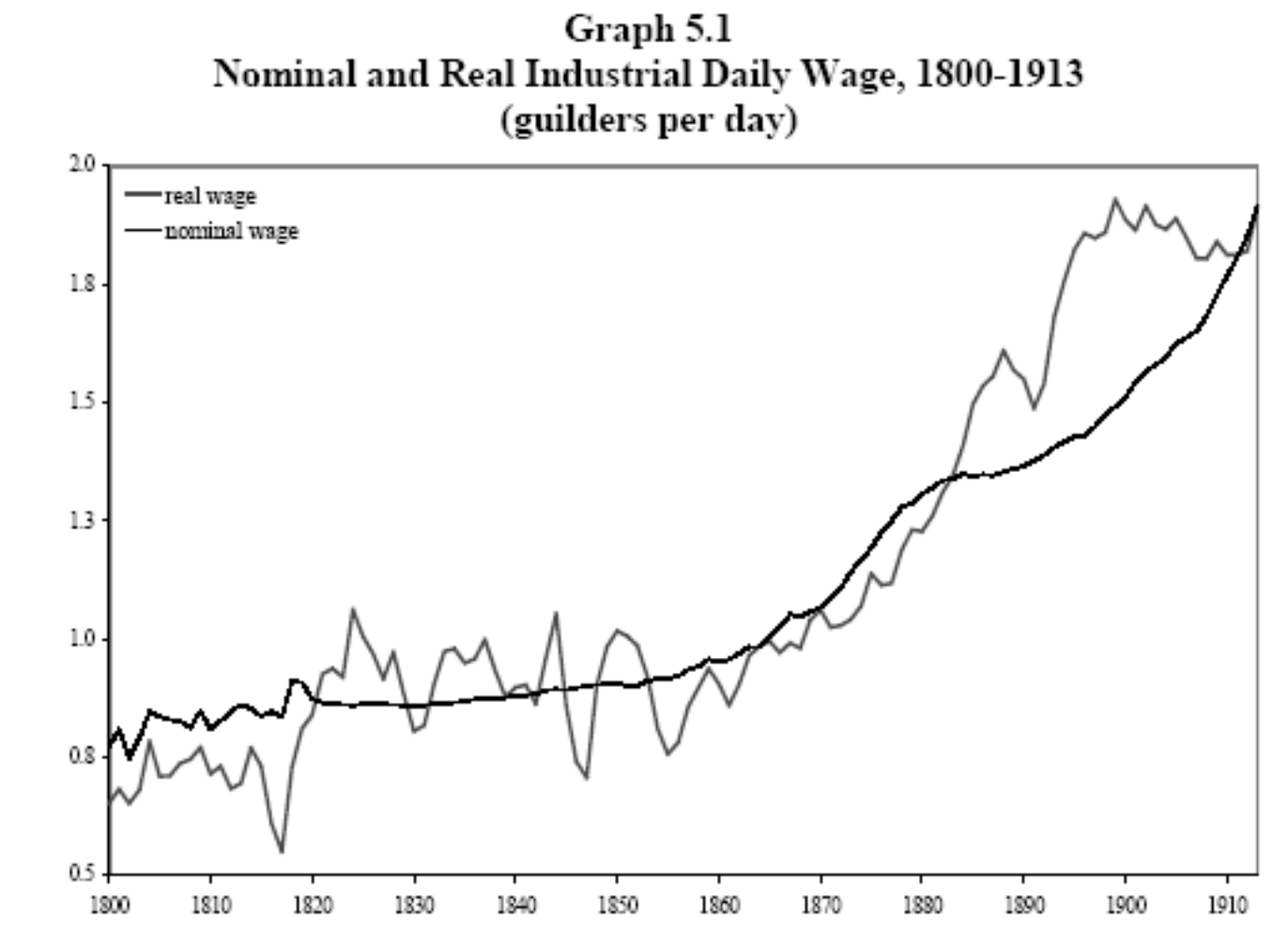
Agenda

- Economic growth and material living standards
- Gender and nutrition
- Female heights: source and development
- Determinants of female height: the individual level
- Determinants of female and male height: time series analysis
- Conclusions

GDP per capita



Real industrial daily wage



Source: J-P Smits et al, Dutch GNP and its Components 1800-1913, Groningen 2000

Per capita food availability

	1807/08	1820/29	1840/49	1850/59	1870/79	1895/1904
Potatoes (kg/y)	122	163	141	149	164	186
Wheat and rye (kg/y)	88	87	99	109	127	153
Meat (kg/y)	37	30	28	26	31	40
Butter (kg/y)	9	7	6	-	-	-
Dairy Products(kg/y)	-	-	-	400	381	349
Kcal/day	c. 2,200			2,227	2,493	2,721
Protein g/day	-	-	-	90	97	104
Fat g/day	-	-	-	46	47	53

Source: De Beer, Voeding, gezondheid en arbeid (Amsterdam, 2001)

Food intake and gender (1)

- Did the declining consumption of animal protein and inadequate intake of food energy have different effects on boys and girls?
- Our hypothesis: the effects were different. Boys, being the future breadwinner, were spared since they had more (future) earning power in market-based production (than women and girls).

Food intake and gender (2):

- Quantitative historical data concerning *individual* food intake are lacking
- Need for reliable indicators of food intake
- Physical stature is a reliable indicator of nutritional status. But nutritional status is not equal to nutritional intake. Nutritional status is influenced by workload and disease environment
- Physical stature however is the only indicator available

Gender and nutritional stress

- Do gender differences in biological adaptation exist? I.e. do decreasing food intake or deteriorating environmental circumstances have a different effect on physical stature?
- Review of recent biomedical literature: studies concerning nutritional supple-mentation

literature review (1)

Study group	Inter-vention	Outcome mea-sures	Results	Source
Preterm infants; body weight < 1800 gram. Hospital setting	Energy supple-ment	Weight, height, head circum-ference	Energy supple-ment of particular benefit for the growth of male infants	Carver JD et al.. Growth of pre-term infants fed nutrient-enriched or term formula after hospital-discharge. Pediatrics. 2001 Apr;107(4): 683-9

literature review (2)

Study group	Interven-tion	Outcome measures	Results	Source
Children born to women who had received nutritional supple-mentation in childhood	None	Height	Effect of maternal nutritional supple-mentation more pronoun-ced in boys.	Stein AD et al. Prospective study of protein-energy supplementation early in life and of growth in the subsequent generation in Guatemala.Am J Clin Nutr. 2003 Jul;78(1):162-7.

literature review (3)

Study group	Inter-ven-tion	Out-come mea-sures	Results	Source
Mode-rately malnou-rished pre-school children, dischar-ged from the hos-pital.	vitamin A sup-ple-menta-tion	Weight, height and mid-upper arm circum-ference	Vitamin A-supplemented boys gained more weight and height than control boys, whereas vitamin A-supplemen-ted girls gained less height than control girls	Donnen P et al. Vitamin A supplemen-tation but not deworming improves growth of malnourished preschool children in eastern Zaire. J Nutr. 1998 Aug;128(8):1320-7.

literature review (4)

Study group	Inter-vention	Out-come mea-sures	Results	Source
Apparently healthy preschool children aged 27-50 mo who attended daycare centers	Zinc supple-menta-tion	Height	Boys from the supplemented group gained 0.9 cm more than those in the placebo group. No effect was seen in girls.	Ruz M et al. A 14-mo zinc-supplemen-tation trial in apparently healthy Chilean preschool-children. Am J Clin Nutr.1997 Dec;66(6):1406-13.

Environmental and nutritional stress

- So according to intervention studies boys seem less resistant to nutritional stress than girls and respond more to dietary supplementation
- Recent “heritability” research (Silventoinen K et al. Heritability of Adult Body Height: A Comparative Study of Twin Cohorts in Eight Countries. Twin Res. 2003 Oct;6(5): 399-408) shows otherwise….

Environmental and nutritional stress

- “Variation in the heritability estimates of body height was larger between our study populations in women compared to men. It has previously been suggested that growth in women is more resistant to environmental stress than that in men but our results do not seem to support this hypothesis. (…) This is probably due to unidentified environmental factors specific to women only, which may vary more in time and between populations”.

Birth regions of female prisoners in Utrecht and nationwide

	Female prisoners			Census data		
Birth decade	Urban %	Modern Rural %	Traditio-nal rural %	Urban %	Modern rural %	Traditio-nal rural %
1810's	71.1	0.0	28.9	39.5	19.6	41.0
1820's	57.0	10.7	32.2	39.2	19.6	41.2
1830's	59.4	9.1	31.5	39.0	19.4	41.6
1840's	55.2	13.1	31.7	39.0	19.5	41.5
1850's	47.5	14.1	38.4	39.3	19.6	41.1
1860's	50.2	9.9	39.9	40.0	19.5	40.6
1870's	46.9	7.8	45.3	41.1	19.4	39.6

Sector of employment of adult female prisoners (N=1,452) and nationwide

Sector	Female prisoners				Census data		
	1860s %	1870s %	1880s %	1890s %	1859 %	1889 %	1899 %
Services	69.4	68.0	69.9	72.4	35.7	47.4	50.4
Agricul-ture	15.3	17.4	17.6	13.8	48.4	37.9	33.0
Industry	15.3	14.7	12.5	13.8	15.9	14.7	16.6

Literacy of female prisoners and nationwide

Birth decade	Female prisoners signing their names (%)	Brides signing their names (%)
1810's	26	Ca 60
1820's	29	Ca 68
1830's	36	Ca 72
1840's	46	Ca 76
1850's	52	Ca 84
1860's	70	Ca 90
1870's	86	-
Sources column 3: Boonstra, OWA, De waardij van eene vroege opleiding (1993), graph 2.2		

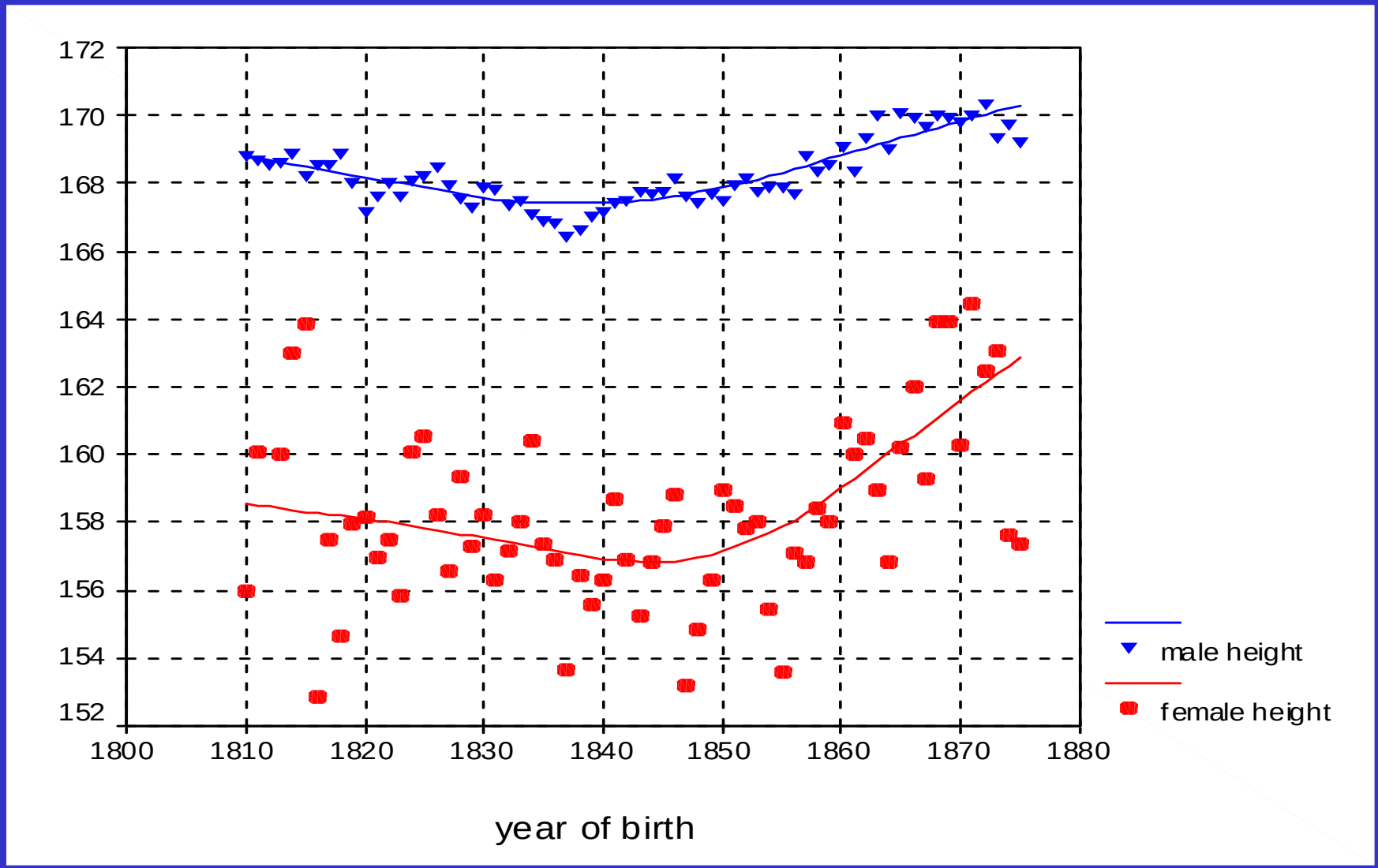
Sample Female Prisoners Representative?

- The sample is not representative of Dutch females: urban females, workers in the services sector and illiterates are over represented;
- It’s likely that average adult physical stature of this sample is not representative of Dutch females’ heights

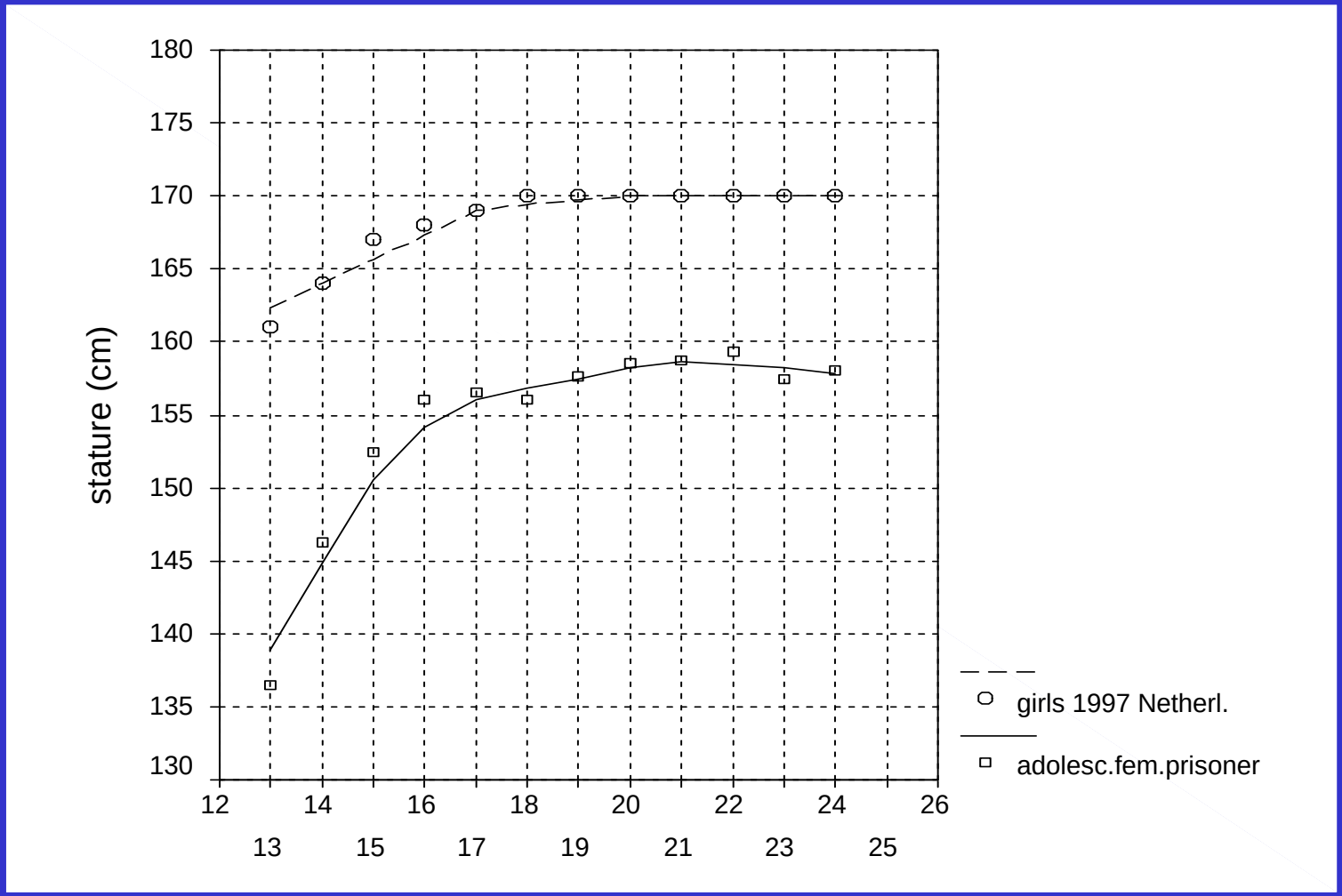
Attempt to reconstruct Dutch adult female height in the underprivileged social classes

- By calculating average height per province per year of birth
- By weighting these average heights with provincial population sizes
- By smoothing the weighted averages through locally weighted regression

Reconstructed Dutch adult female height



Adolescent female stature



Determinants of adult female height development: the individual level

	Unstandard. Coeff.	T	Sign.
Constant	157.256	168.920	0.000
1823-35	0.627	0.690	0.490
1836-48	-0.799	-0.926	0.355
1849-61	0.311	0.353	0.724
1862-74	3.200	3.383	0.001
literacy	1.345	3.763	0.000
Agriculture	0.010	0.016	0.987
Industry	-0.420	-0.646	0.518
Service	0.077	0.206	0.837
OLS regression; To be continued			

Determinants of adult female height development: the individual level

	Unstandard.Coeff.	T	Sign.
NH	-1.160	-1.661	0.097
ZH	0.137	-0.199	0.843
FR	0.657	0.810	0.418
GR	-0.855	-0.958	0.338
DR	0.613	0.525	0.599
OV	-0.117	-0.170	0.865
UT	-0.594	-1.196	0.232
ZLD	-1.612	-0.913	0.361
NB	-2.189	-2.356	0.019
OLS regression; To be continued			

Determinants of adult female height development: the individual level

	Unstandard. Coeff.	T	Sign.
LI	-1.141	-0.707	0.479
OLS regression R Square 0.064			

Determinants of adolescent female height: the individual level

	Unstandard. Coeff.	T	Sign.
Constant	145.551	70.669	0.000
AGE15	6.819	2.913	0.004
AGE16	10.211	4.692	0.000
AGE17	10.878	5.294	0.000
AGE18	10.809	5,286	0.000
AGE19	12.206	5.877	0.000
AGE20	13.569	6.609	0.000
literacy	1.986	2.793	0.005
OLS regression; Continued			

Determinants of adolescent female height: the individual level

	Unstandard. Coeff.	T	Sign.
1843-52	-2.533	-2.314	0.021
1853-62	-1.491	-1.424	0.155
1863-72	0.063	0.068	0.946
Urban region	-0.695	-0.966	0.334
Modern rural region	-0.443	-0.376	0.707
OLS regression; R square 0.159; N=410			

Determinants of adult female height development: time series analysis

	Unstandard. Coeff.	T	Sign.
Constant	153.966	17.221	0.000
Meat (kcal p.h.p.d.) 1st year of life	0.023	0.750	0.457
Potatoes, rye and wheat (kcal p.h.p.d.) 1st year of life	0.001	0.161	0.872
Crude Death Rate 1st year of life	-0.029	-0.189	0.851
R Sq 0.016; DW: 2.056; Rho: 0.439; SE Rho: 0.119 Autoreg model Prais-Winsten Est.			

Determinants of adult male height development: time series analysis

	Unstandard. Coeff.	T	Sign.
Constant	168.240	84.818	0.000
Meat (kcal p.h.p.d.) 1st year of life	0.001	0.115	0.909
Potatoes, rye and wheat (kcal p.h.p.d.) 1st year of life	-0.001	-0.788	0.434
Crude Death Rate 1st year of life	0.024	0.913	0.365
R Sq 0.034; DW: 2.465; Rho: 0.889; SE Rho: 0.061 Autoreg model Prais-Winsten Est.			

Determinants of adult female height development: time series analysis

	Unstandard. Coeff.	T	Sign.
Constant	147.425	16.842	0.000
Meat (kcal p.h.p.d.) 2nd year of life	0.036	1.169	0.247
Potatoes, rye and wheat (kcal p.h.p.d.) 2nd year of life	0.001	0.173	0.863
Crude Death Rate 2nd year of life	0.132	0.880	0.382
R Sq 0.028; DW: 2.095; Rho: 0.437; SE Rho: 0.118; Autoreg model Prais-Winsten Est.			

Determinants of adult male height development: time series analysis

	Unstandard. Coeff.	T	Sign.
Constant	171.353	87.658	0.000
Meat (kcal p.h.p.d.)2nd year of life	-0.010	-1.517	0.135
Potatoes, rye and wheat (kcal p.h.p.d.) 2nd year of life	-0.0001	-0.144	0.886
Crude Death Rate 2nd year of life	-0.033	-1.291	0.202
R Sq 0.049; DW: 2.402; Rho: 0.888; SE Rho: 0.060; Autoreg model Prais-Winsten Est.			

Determinants of adult female height development: time series analysis

	Unstandard. Coeff.	T	Sign.
Constant	139.460	16.306	0.000
Meat (kcal p.h.p.d.) 3rd year of life	0.022	0.754	0.454
Potatoes, rye and wheat (kcal p.h.p.d.) 3rd year of life	0.008	2.410	0.019
Crude Death Rate 3rd year of life	0.251	1.521	0.134
R Sq 0.122; DW: 1.853. Rho: 0.263; SE Rho: 0.126; Autoreg model Prais-Winsten Est.			

Determinants of adult male height development: time series analysis

	Unstandard. Coeff.	T	Sign.
(Constant)	163.981	88.460	0.000
Meat (kcal p.h.p.d.) 3rd year of life	0.008	1.216	0.229
Potatoes, rye and wheat (kcal p.h.p.d.) 3rd year of life	0.002	2.391	0.020
Crude Death Rate 3rd year of life	0.047	1.915	0.060
R Sq 0.120; DW: 2.334. Rho: 0.872; SE Rho: 0.064; Autoreg model Prais-Winsten Est.			

Conclusions

- During the initial phase of modern economic growth both adult male and adult female heights deteriorated somewhat.
- Neither adult male nor adult female height was significantly influenced by the consumption of meat.
- Caloric consumption of potatoes and bread had a significant effect on both *male* and *female* heights, but only in the 3rd year of life.

Conclusions

- Our findings don't support the notion that 'females often (…) experienced a decline in their physical stature prior to that of males'.
  (John Komlos and Jörg Baten, "Looking Backward and Looking Forward: Anthropometric Research and the Development of Social Science History"; http://epub.ub.uni-muenchen.de)
- Our hypothesis of discrimination concerning nutrition against Dutch females in the 19th century seems to be implausible.

Conclusions

- Perhaps the absence of discrimination against females concerning nutrition and health in the Netherlands was to be expected because of the long-standing ideals about motherhood and child care, which can be traced back to early-modern Dutch culture.
- The importance of these ideals is reflected in the circumstance that until very recently the Dutch women's share in the total labor force has been markedly lower than in other European countries